

# USER'S HANDBOOK

1061A 1061

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**datron**  
I N S T R U M E N T S

**digital voltmeters**

## 1061 and 1061A [5] Specifications

### DC VOLTAGE

Full Range Count (FR) :  $\pm 100,000$  (1,000,000)  
 Full Scale Count (FS) :  $\pm 199,999$  (1,999,999) on all ranges  
 except 1000V range  
*Superfast Mode Full Scale Count : 19,999 on all ranges  
 except 1000V range*

#### ACCURACY

24 HOURS ( $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ) Relative to calibration standards.

\*0.1V range:  $\pm 10\text{ppm}$  of reading  $\pm 2$  digits (16)  
 1 and 10V ranges:  $\pm 5\text{ppm}$  of reading  $\pm 1$  digit (8)  
 100 and 1000V ranges:  $\pm 10\text{ppm}$  of reading  $\pm 1$  digit (8)

90 DAYS ( $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ )

\*0.1V range:  $\pm 30\text{ppm}$  of reading  $\pm 2$  digits (16)  
 1 and 10V ranges:  $\pm 20\text{ppm}$  of reading  $\pm 1$  digit (8)  
 100 and 1000V ranges:  $\pm 30\text{ppm}$  of reading  $\pm 1$  digit (8)

1 YEAR ( $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ )

\*0.1V range:  $\pm 45\text{ppm}$  of reading  $\pm 2$  digits (16)  
 1 and 10V ranges:  $\pm 30\text{ppm}$  of reading  $\pm 1$  digit (8)  
 100 and 1000V ranges:  $\pm 45\text{ppm}$  of reading  $\pm 1$  digit (8)

*Superfast Mode (all ranges) :  $\pm$  above ppm of reading  $\pm 1$  digit*

TEMPERATURE COEFFICIENT : ( $10^{\circ}\text{C}$  to  $35^{\circ}\text{C}$ )  
 1/10th of 90 DAY specification  $\pm 0.2\mu\text{V}/^{\circ}\text{C}$

#### READ RATE

Normal Mode

All DC ranges : 3/second (internal trigger) with full scale input  
 30/35 per second (external trigger) with full  
 range input at 50/60Hz

*Superfast Mode*

*All ranges: 200/second (external trigger) with  
 full range input.*

SETTLING TIME (to 10 ppm of step size) [1]

Filter out :  $< 5\text{ms}$

Filter in :  $< 350\text{ms}$

#### SERIES MODE REJECTION

Filter out : 66dB @ line frequency

Filter in : add 34dB @ 50Hz increasing at  
 18dB/octave

#### COMMON MODE REJECTION

1k $\Omega$  source unbalance

$> 140\text{dB}$  at DC

$> 80\text{dB}$  + series mode at 1Hz to 60Hz

#### AUTORANGE SPEED (No filter)

Typically 100ms per range between top and bottom  
 ranges.

#### INPUT RESISTANCE

0.1 to 10 Volt ranges ( $< 20$  volts) :  $> 10,000\text{M}\Omega$

100 and 1000 Volt ranges :  $10\text{M}\Omega \pm 0.1\%$ .

#### INPUT CURRENT (1 year)

$< 50\text{pA}$  drifting at  $< 2\text{pA}/^{\circ}\text{C}$ .

### RESISTANCE

Full Range Count : 100,000 (1,000,000)  
 Full Scale Count : 199,999 (1,999,999)  
*Superfast Mode Full Scale Count : 19,999*

#### ACCURACY

24 HOURS ( $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$ )

\*10 $\Omega$  range:  $\pm 15\text{ppm}$  of reading  $\pm 2$  digits (16)  
 0.1k $\Omega$ , 1k $\Omega$ , 10k $\Omega$  ranges:  $\pm 10\text{ppm}$  of reading  $\pm 1$  digit (8)  
 100k $\Omega$  range:  $\pm 15\text{ppm}$  of reading  $\pm 1$  digit (8)  
 1000k $\Omega$  range:  $\pm 30\text{ppm}$  of reading  $\pm 1$  digit (8)  
 10M $\Omega$  range:  $\pm 150\text{ppm}$  of reading  $\pm 1$  digit (8)

90 DAYS ( $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ )

\*10 $\Omega$  range:  $\pm 40\text{ppm}$  of reading  $\pm 2$  digits (16)  
 0.1k $\Omega$ , 1k $\Omega$ , 10k $\Omega$  ranges:  $\pm 30\text{ppm}$  of reading  $\pm 1$  digit (8)  
 100k $\Omega$  range:  $\pm 40\text{ppm}$  of reading  $\pm 1$  digit (8)  
 1000k $\Omega$  range:  $\pm 100\text{ppm}$  of reading  $\pm 1$  digit (8)  
 10M $\Omega$  range:  $\pm 300\text{ppm}$  of reading  $\pm 1$  digit (8)

1 YEAR ( $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ )

\*10 $\Omega$  range:  $\pm 60\text{ppm}$  of reading  $\pm 2$  digits (16)  
 0.1k $\Omega$ , 1k $\Omega$ , 10k $\Omega$  ranges:  $\pm 45\text{ppm}$  of reading  $\pm 1$  digit (8)  
 100k $\Omega$  range:  $\pm 60\text{ppm}$  of reading  $\pm 1$  digit (8)  
 1000k $\Omega$  range:  $\pm 200\text{ppm}$  of reading  $\pm 1$  digit (8)  
 10M $\Omega$  range:  $\pm 500\text{ppm}$  of reading  $\pm 1$  digit (8)

*Superfast Mode : As DC Volts*

TEMPERATURE COEFFICIENT : ( $10^{\circ}\text{C}$  to  $35^{\circ}\text{C}$ )  
 1/10th of 90 DAY specification  $\pm 100\mu\Omega/^{\circ}\text{C}$

#### READ RATE

Normal Mode

All ranges : As DC Volts.

*Superfast Mode : As DC Volts*

#### TYPE

True 4-wire with active guard (can be switched to 2-wire  
 on the front panel).

Measurement technique is independent of the internal  
 reference voltage.

#### OPEN CIRCUIT VOLTAGE

$< 10$  volts on all ranges

#### LEAD RESISTANCE

Up to 100 $\Omega$  may be tolerated in any or all the leads on  
 any range. (Rejection of lead resistance is 100dB on  
 any range).

#### RESPONSE TIME

Depends on external capacitance and guarding/shielding  
 techniques used.

Generally up to 10k $\Omega$  response as DC Volts.

Higher resistances take longer to settle.

OHMS GUARD may be used to guard out stray capacitance.

#### CURRENT THROUGH UNKNOWN ( $\pm 1\%$ )

10 $\Omega$ , 0.1k $\Omega$  ranges : 10mA

1k $\Omega$  range : 1mA

10k $\Omega$  range : 100 $\mu\text{A}$

100k $\Omega$  range : 10 $\mu\text{A}$

1000k $\Omega$  range : 1 $\mu\text{A}$

10M $\Omega$  range : 100nA

#### OHMS GUARD

Drive Capability: I+ or I- to OHMS GUARD,

250 $\Omega$  minimum (up to 10 $\Omega$  lead resistance)

Guarding Accuracy : See Section 2 - 'Resistance measurement'.

\*Within 15 minutes of 'Input Zero' correction and 'Input Filter' selected or add 5 $\mu\text{V}$  per year

[1] or  $< 3$  digits or 1ppm of step size (whichever is greater) following a range change

[5] Count and Accuracy figures in brackets refer to 1061A in 'Filter' Mode (6 $\frac{1}{2}$  digits)

NOTE: SUPERFAST selected by remote programming only

## 1061 Specifications (cont.)

### AC VOLTAGE (TRUE RMS – OPTION 10)

Full Range Count : 100,000

Full Scale Count : 199,999 on all ranges except 1000V range

**ACCURACY** (Signals  $< 2 \times 10^7$  Volt Hz,  $> 0.25\%$  Full Scale)

	DC + 45Hz [2] to 5kHz
<b>24 HOURS</b> (23°C ± 1°C) Relative to calibration standards.	
0.1V and 1000V ranges:	± 0.04% of reading ± 40 digits
1 to 100V ranges:	± 0.02% of reading ± 20 digits
<b>90 DAYS</b> (23°C ± 5°C)	
0.1V and 1000V ranges:	± 0.08% of reading ± 40 digits
1 to 100V ranges:	± 0.04% of reading ± 20 digits
<b>1 YEAR</b> (23°C ± 5°C)	
0.1V and 1000V ranges:	± 0.12% of reading ± 40 digits
1 to 100V ranges:	± 0.06% of reading ± 20 digits

DC + 5kHz to 100kHz

± 0.1% of reading ± 100 digits  
± 0.05% of reading ± 50 digits

± 0.2% of reading ± 100 digits  
± 0.1% of reading ± 50 digits

± 0.3% of reading ± 100 digits  
± 0.15% of reading ± 50 digits

**HF ACCURACY** [3] (1 and 10V ranges)

100kHz to 1MHz ± 2% of reading ± 2000 digits (typical)

**INPUT IMPEDANCE**

1MΩ shunted by 150pF

**LF ACCURACY**

Filter out, at line frequency add: ± 0.6% of reading  
Filter in, 10Hz : ± 2.0% of reading

**CONVERSION TYPE**

True RMS AC coupled (measures AC component with up to 1000V DC bias on any range, subject to the constraints of Section 2, Table 2.1).

or

True RMS DC coupled (measures  $\sqrt{AC^2 + DC^2}$ )

**CREST FACTOR**

7 : 1 typically, at full range

**SETTLING TIME** (DC coupled)

(i) To 0.1% of step size

Filter out  $< 150\text{ms}$   
Filter in  $< 500\text{ms}$

**TEMPERATURE COEFFICIENT**

$< 1/10\text{th}$  of 90 DAY specification/°C

**COMMON MODE REJECTION**

1kΩ unbalance  $> 90\text{dB}$  @ DC – 60Hz

(ii) From DC bias input (AC coupled) or severe overload:  
Depends on change of DC bias  
(CR time constant 0.22 seconds)

**READ RATE** (with full scale input) : 3 readings/second.

### DC CURRENT

(applicable only if option 12 is not fitted)

Full Range Count : ± 100,000

Full Scale Count : ± 199,999

Superfast Mode Full Scale Count : 19,999

**ACCURACY**

**24 HOURS** (23°C ± 1°C) Relative to calibration standards

0.1 to 100mA ranges: ± 50ppm of reading ± 4 digits

1000mA range: ± 100ppm of reading ± 4 digits

**90 DAYS** (23°C ± 5°C)

0.1 to 100mA ranges: ± 100ppm of reading ± 4 digits

1000mA range: ± 200ppm of reading ± 4 digits

**1 YEAR** (23°C ± 5°C)

0.1 to 100mA ranges: ± 150ppm of reading ± 4 digits

1000mA range: ± 300ppm of reading ± 4 digits

Superfast Mode : As DC volts.

**TEMPERATURE COEFFICIENT**

1/10th of 90 DAY specification/°C

**READ RATE** : As DC Volts

**SETTLING TIME** : As DC Volts

**SHUNT RESISTANCE**

0.1mA range : 1kΩ

1mA range : 100Ω

10mA range : 10Ω

100mA range : 1Ω

1000mA range : 0.1Ω

Internal lead resistance:  $< 20\%$  of shunt resistance + 1Ω.

**INPUT PROTECTION**

Overloads :  $< 2\text{A}$ , internally clamped  
 $\geq 2\text{A}$ , rear panel fuse

### AC CURRENT (TRUE RMS)

(in conjunction with option 10 only)

Full Range Count: 100,000

Full Scale Count : 199,999

**ACCURACY** DC + 45Hz [2] to 5kHz

(Signals  $> 0.1\%$  Full Scale)

**24 HOURS** (23°C ± 1°C) Relative to calibration standards

0.1 to 1000mA ranges: ± 0.1% [4] of reading ± 100 digits

**90 DAYS** (23°C ± 5°C)

0.1 to 1000mA ranges: ± 0.2% [4] of reading ± 100 digits

**1 YEAR** (23°C ± 5°C)

0.1 to 1000mA ranges: ± 0.3% [4] of reading ± 100 digits

**CREST FACTOR**

3 : 1 typically, at full range

**TEMPERATURE COEFFICIENT**

$< 1/10\text{th}$  of 90 Day specification/°C

**READ RATE** : As AC volts

**SETTLING TIME** : As AC volts

**SHUNT RESISTANCE** : As DC current

**CONVERSION TYPE**

True r.m.s. AC coupled or DC coupled

**INPUT PROTECTION**

As DC Current but large DC bias may cause protection to operate as the AC coupling is provided after current shunts.

[2] Read 360Hz instead of 45Hz if 'Input Filter' not selected.

[3] Spec read-out invalid above 100kHz.

[4] Typical above 1kHz.

## HIGH PERFORMANCE AC VOLTAGE (TRUE RMS – OPTION 12)

Full Range Count: 100,000 (1,000,000)

Full Scale Count: 199,999 (1,999,999) on all ranges except 1000V Range

### ACCURACY

(For signals  $< 2 \times 10^7$  Volt Hz,  $> 0.25\%$  Full Scale)

( $\pm$  % reading  $\pm$  digits)

DC + 45Hz - 2kHz [2] [5]

2kHz - 30kHz [5] [6]

30kHz - 100kHz [5] [6]

24 HOURS (23°C  $\pm$  1°C) Relative to calibration standards

0.1V & 1000V ranges: 0.02  $\pm$  15(150)

0.04  $\pm$  30(300)

0.08  $\pm$  45(450)

1V to 100V ranges: 0.01  $\pm$  10(100)

0.02  $\pm$  20(200)

0.04  $\pm$  40(400)

90 DAYS (23°C  $\pm$  5°C)

0.1V & 1000V ranges: 0.04  $\pm$  15(150)

0.08  $\pm$  30(300)

0.20  $\pm$  45(450)

1V to 100V ranges: 0.025  $\pm$  10(100)

0.05  $\pm$  20(200)

0.10  $\pm$  40(400)

1 YEAR (23°C  $\pm$  5°C)

0.1V & 1000V ranges: 0.05  $\pm$  15(150)

0.10  $\pm$  30(300)

0.25  $\pm$  45(450)

1V to 100V ranges: 0.03  $\pm$  10(100)

0.06  $\pm$  20(200)

0.15  $\pm$  40(400)

### LF ACCURACY

Filter out, at line frequency:  $\pm 0.6\%$  of reading

Filter in, 10Hz :  $\pm 2\%$  of reading

HF ACCURACY: 100kHz - 1MHz [3]

1V & 10V Ranges 2%  $\pm$  2000(20,000)

### DC COUPLING

Add to main specification 0.01%  $\pm$  3(30)  $\pm$  10 $\mu$ V.

### CONVERSION TYPE

True RMS AC coupled (measures AC component with up to 1000V DC bias on any range, subject to the constraints of Section 2, Table 2.1).

### CREST FACTOR

5 : 1, at full range

or

True RMS DC coupled (measures  $\sqrt{AC^2 + DC^2}$ )

### TEMPERATURE COEFFICIENT

$< 1/10$ th of 90 day specification /°C

### COMMON MODE REJECTION

1k $\Omega$  source unbalanced:  $> 90$ dB @ DC – 60Hz

### SETTLING TIME (DC coupled)

(i) To 0.1% of step size:

Filter out  $< 200$ ms

Filter in  $< 1.25$ s

### INPUT IMPEDANCE

1M $\Omega$  shunted by 150pF

(ii) From DC bias input (AC coupled) or severe

overload: Depends on DC bias, (CR time constant 0.22 seconds)

### READ RATE

With full scale input: 3/s

### Notes:

[2] Read 360Hz instead of 45Hz if "Input Filter" not selected

[3] Spec read-out invalid above 30kHz

[5] Count and accuracy figures in brackets refer to 1061A in "Filter" mode (6½ digits)

[6] Add 0.01% per 100V above 500V

## Standard internal delays

An internal time delay is introduced between receipt of any trigger pulse and the start of a measurement cycle.

It is therefore possible for a user to apply the trigger and signal simultaneously, knowing that the input circuitry will have settled to the new signal level before the measurement cycle begins.

To optimize maximum read-rate with adequate settling time, the size of the internal delay is standardized for various combinations of function and range selection. These variations are shown in the following tables:

1061/1061A		Filter Out (ms)	Filter In (ms)
Function	Range		
DCV	all	5	500
(Option 12) ACV DCV + ACV	all	300	1250
(Option 10) ACV DCV + ACV ACI DCI + ACI	all	225	750
DCI	100 $\mu$ A-1mA 10mA 100mA 1A	5 10 20 25	500
k $\Omega$	10 $\Omega$ -100k $\Omega$ 1M $\Omega$ 10M $\Omega$	5 15 150	500 600 1250

1071		Filter Out (ms)	Filter In (ms)
Function	Range		
DCV DCI	all	50	1000
ACV DCV + ACV ACI DCI + ACI	all	230	750
k $\Omega$	10 $\Omega$ -100k $\Omega$ 1M $\Omega$ 10M $\Omega$	50 50 310	1000 1200 2500

In addition to all the delays shown above, two further delays are imposed:

Range change — 10V-100V : 25ms  
Function change : 100ms